

DOCUMENT RESUME

ED 196 406

IR 008 928

AUTHOR Joseph, John H.
TITLE The Effect of Level of Knowledge of the Subject on the Instructional Effectiveness of Illustrations Which Integrate Abstract and Realistic Visualization.
PUB DATE 23 Apr 80
NOTE 16p.: Paper presented at the Annual Convention of the Association for Educational Communications and Technology (Denver, CO, April 21-24, 1980). For the complete proceedings of the Research and Theory Division, see IR 008 914.
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Audiotape Recordings: *Illustrations; *Instructional Design; *Intermode Differences; Media Research; Outcomes of Education; *Visual Discrimination; *Visual Learning; *Visual Perception

ABSTRACT

This study examines the effect of an entering behavior, i.e., the level of general knowledge of the subject matter, on the instructional effectiveness of illustrations which integrate abstract and realistic visualization. Subjects were 414 public school students who were divided into three groups according to their general level of knowledge of the subject matter as measured by a pretest. Four types of visualization were compared under two methods of instruction, and criterion tests measured learning for five types of instructional objectives. Scores on four criterion tests were combined to form a total criterion test measure which was administered on the day following the instruction and again after two weeks. Results of both posttests suggest that designers of visualized instruction should consider the students' level of knowledge of the subject in determining the type of visualization to be used. Although students with a low level of general knowledge of the subject may find all types of visuals equally effective, student with moderate and high levels of knowledge of the subject may benefit from realistic visualization or illustrations which integrate abstract and realistic visualization, depending on the pacing of the instruction and the type of instructional objective. (Author/CHC)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

The Effect of Level of Knowledge of the Subject
on the Instructional Effectiveness of Illustrations
Which Integrate Abstract and Realistic Visualization

John H. Joseph

The Pennsylvania State University

The Capitol Campus

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Michael Simonson

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

Paper Presented at the 1980 Annual Convention
Association for Educational Communication and Technology
Research and Theory Division

Denver, Colorado

April 23, 1980

ED196406

IR008928

Purpose

This study examines the effect of an entering behavior, specifically the level of general knowledge of the subject matter, on the instructional effectiveness of illustrations which integrate abstract and realistic visualization.

The relative effectiveness of abstract and realistic visualization has become a perennial issue. A general preference for realism is reinforced by several theorists. Dale's (1946) "Cone of Experience," Carpenter's (1953) "Sign Similarity Hypothesis," and Morris' (1946) "Iconicity Theory" are also supportive of the notion. The preference is also based partly on the affective value of realistic visuals. Findings of a general preference for complex detailed illustrations, particularly by older children and adults (French, 1952; Spaulding, 1955; Hanes, 1973) support this intuitive basis. Dember (1960), Yarbus (1967), Kahneman (1973), and Haber (1973) cite evidence that complexity is a major determinant of attention.

Other theorists (Broadbent, 1958, 1965; Travers, 1964, 1970; Dwyer, 1972) argue that an increase in realism will not necessarily lead to increased learning. These researchers feel that the irrelevant cues may interfere with learning. Travers (1964) advocates that the discarding of less important information and the retention of more important should be done for the learner to assure effectiveness (pp. 380-382). Hochberg suggests that "the characteristics of a given object may be communicated better as the representational fidelity of the surrogate deteriorates" (1962, p. 30). Dwyer (1972) found evidence to support this notion under certain conditions.

Dwyer found that the type of visual illustration (abstract vs realistic) which was most effective for instruction was dependent upon the type of information to be transmitted (or, the kind of objective), whether the instruction was self-paced or externally-paced, the grade level, and the level of entering behavior of the students (1972). The type of illustration most effective was also found to be dependent on the level of general ability (IQ) (1976). For certain educational objectives, Dwyer found no significant differences between verbal only and visualized treatments (1972).

Joseph (1978) found that the inclusion of realistic visualization improved instructional effectiveness under general conditions. The effectiveness of abstract visualization was found to be dependent on pacing (external vs internal), general ability, and the type of instructional objective. Integration of abstract and realistic visualization was found to improve effectiveness for externally-paced instruction under certain conditions.

Gagne (1967) supports the view that learning "is a highly idiosyncratic event, and depends very much on the nature of the learner, particularly on his own past learning."

Davis, Alexander and Yelon (1974) emphasize: "the most critical factor in determining student achievement on an instructional unit, is how much he knows about the material to be covered when he enters the unit. Consequently, it is absolutely essential to control for this factor when comparing two methods of instruction."

The purpose of this study was to investigate the effect of the level of knowledge of the subject on the instructional effectiveness of illustrations which integrate abstract and realistic visualization. Two methods of integrating the visualization were investigated. The first was with a hybrid illustration, a real color photograph into which a line drawing segment has been inserted. This provided an abstract illustration of the important relevant elements to be communicated, as well as a realistic context. The second method was through the simultaneous presentation of both a line drawing and a real color photograph. In this treatment the abstract line drawing could communicate the essential information and/or facilitate looking at the realistic illustration. The realistic illustration, on the other hand, could motivate and arouse as well as communicate essential information. The effectiveness of these treatments was measured for five kinds of learning objectives, externally-paced and self-paced methods of instruction, immediate and delayed retention, and three levels of prior knowledge of the subject.

Procedure

Subjects were 414 tenth grade public school students enrolled in mandatory health classes. Classes were coeducational and there was no ability grouping. The subjects were stratified into three groups on the basis of their scores on a physiology pretest which was administered during the two weeks prior to receipt of the instructional unit. The test is the same instrument used as a pretest by Dwyer (1972). There are 36 multiple choice items regarding general human physiology. Raw scores ranged from

three to 33, with a mean of 17.1 and standard deviation of 5.8. The reliability (Kuder-Richardson 21) of the test was .75.

The instructional unit and criterion tests were those developed and used by Dwyer (1972). The 2,000 word instructional script deals with the construction and operation of the heart and is accompanied by 37 visuals which illustrate concepts and relationships for which visualization is likely to be beneficial.

The criterion tests were a drawing test with 18 items and identification, terminology and comprehension tests with 20 items each. Together these four tests constituted a total criterion test. Reliabilities (KR-20) of the individual tests equal or exceed .76. The reliability of the total test is .91, according to Dwyer (1972, p. 12).

Half of the subjects received self-paced written instruction and half received externally-paced instruction by an audio tape recording (with visuals in booklet form for both modes). Within each of these two modes the students received one of the five treatments: instruction with simple line drawings, instruction with realistic color photographs (3X5 inches), instruction with both line drawings and color photographs, instruction with hybrid illustrations of realistic photograph and line drawing segments, and a control group with no visuals. Treatments were randomly assigned to subjects. All students received the four-part criterion test on the day immediately following the instruction and again after two weeks.

The analysis involved a three-factor design denoted RS_n in $(A_5 @ P_2 @ C_3)$. Random subjects were nested in cells formed by the three factors:

Factor A: Five levels of the instruction variable, 1) no illustration

(control), 2) line drawing, 3) real photograph, 4) hybrid illustration and 5) both a line drawing and a real photograph.

Factor B: Two levels of the presentation mode variable, 1) externally-paced and, 2) internally-paced.

Factor C: Three levels of the entering behavior variable, 1) low, 2) medium and 3) high knowledge of the subject.

The analysis was completed for five levels of the dependent criterion variable, 1) drawing test score, 2) identification test score, 3) terminology test score, 4) the comprehension test score and 5) a total criterion test score which combined the other 4 scores. Scores on these tests were transformed to standard scores before analysis.

The library program RUMMAGE was used for the analysis of variance computations. This program will handle balanced and unbalanced experimental designs, missing data and transformations. Cell sizes averaged 12 for the immediate posttest and 14 for the delayed posttest.

Immediate Posttest: Results

Drawing Test

The analysis of variance procedure for the drawing test produced a significant* F value for the AC interaction (type of visualization vs. level of prior knowledge) and for B factor (pacing).

Tests of the B means indicated that the externally-paced subjects scored significantly higher than the self-paced subjects.

Figure 1 illustrates the AC means. There were no significant differences between the means for the low prior knowledge group. For the medium level,

* $\alpha = .05$ for all tests

the Both Treatment was significantly more effective than the control group.

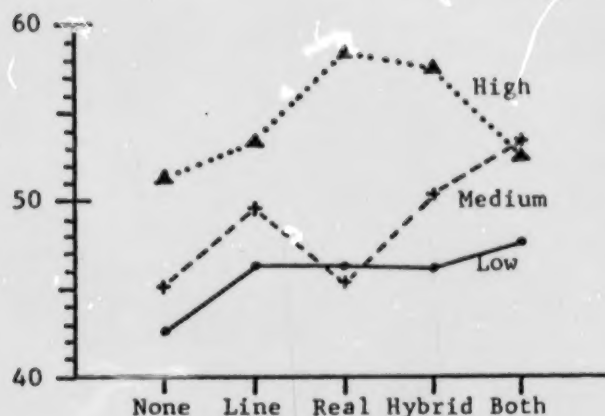


Figure 1 Drawing Test

For the high level, the Real photograph and the Hybrid illustration were significantly more effective than the control group.

Identification Test

The analysis of variance procedure for the identification test produced a significant F value for the ABC interaction. Figures 2 and 3 illustrate the AC means for externally- and self-paced instruction, respectively. There were no significant differences between the means for the low level prior knowledge groups. For the medium level, with external pacing, the Both treatment was significantly more effective than the control group. For the high level, with external pacing, the Both treatment was significantly less effective than the

other four treatments. In the high level group with self-paced materials,

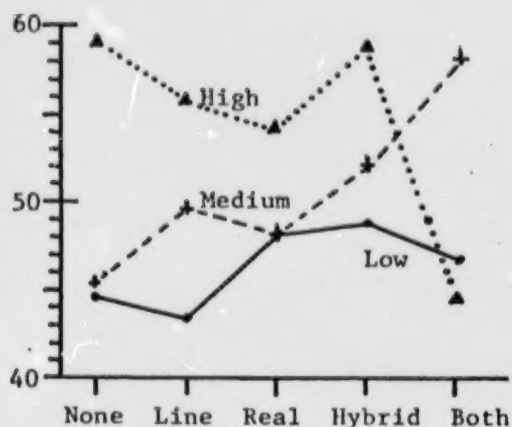


Figure 2 Identification Test
(Externally-paced)

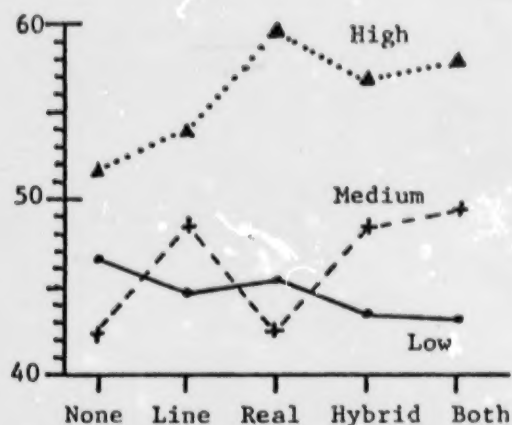


Figure 3 Identification Test
(Self-paced)

the real photograph was significantly more effective than the control group.

Terminology Test

Only the prior knowledge factor (C) produced a significant F ratio in the analysis of variance procedure for the terminology test. For this test the mean of the high level group was significantly higher than those of the medium and low level groups. The low and medium level groups did not differ significantly.

Comprehension Test

Only the prior knowledge factor again produced a significant F ratio for the comprehension test. Results of the pair-wise comparisons of means were identical to those for the Terminology test above

Total score

The analysis of variance procedure for the total scores produced a significant F value for the ABC interaction. Figures 4 and 5 illustrate the AC means for externally-paced and self-paced instruction, respectively.

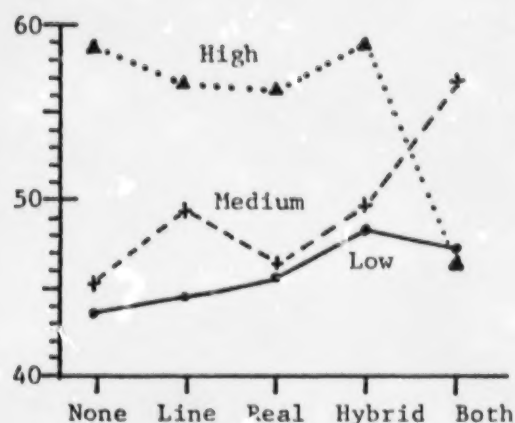


Figure 4 Total Score
(Externally-paced)

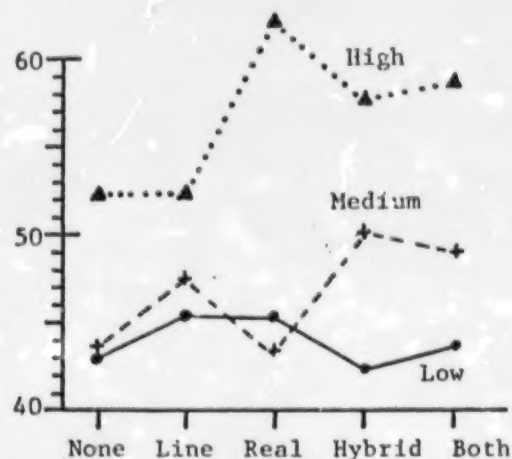


Figure 5 Total Score
(Self-paced)

There were no significant differences between the means for the low level prior knowledge group.

For the medium level, with external pacing the Both treatment was significantly more effective than the control group.

For the high level, with external pacing, the Both treatment was significantly less effective than the other four treatments. In the high level group with self-paced materials, the Real photograph was significantly more effective than the control group. These results for the total test score were identical to those for the identification test.

Immediate Posttest: Discussion

The results seemed to indicate that for students with little prior knowledge of the subject, the various types of visuals are equally effective. However, for students with medium and high levels of prior knowledge of this subject some types of visuals are more effective than others, depending on the method of instruction.

Students with a medium level of knowledge of the subject benefited from simultaneous presentation of both real and abstract visuals particularly for the kind of learning measured by the drawing test and, when externally paced, by the identification test and total test score.

The realistic visual was most effective for high level groups, particularly for the drawing test and, when self-paced instruction was used, for the identification and total test scores. The disparate result for the Both treatment with high level students in the externally-paced mode merits further investigation. If it is not spurious, it may suggest that this redundant illustration interferes with learning for students with high prior knowledge of the subject.

The results lend support to the notion that the effectiveness of certain types of visuals is related to the level of prior knowledge of the subject. Students with moderate levels of prior knowledge of the subject benefit from the integration of realistic and abstract visualization, particularly when

instruction is externally-paced. Students with high levels of prior knowledge of the subject are able to benefit more from realistic visuals, particularly when instruction is self-paced.

Delayed Posttest: Results

Drawing Test

Only the prior knowledge factor (C) produced a significant F ratio in the analysis of variance procedure for the drawing test. For this test the scores of the low prior knowledge group were significantly lower than those of the medium and higher groups. Similarly, the medium prior knowledge group scored significantly lower than the high group.

Identification Test

Only the prior knowledge factor produced a significant F ratio for the identification test as well. The low and medium level groups were not significantly different. However, both differed significantly from the high level group.

Terminology Test

The analysis of variance procedure revealed a significant ABC interaction for the terminology test scores. Figures 6 and 7 illustrate the AC means for external and self-paced instruction respectively.

For the low level group with self pacing, the real photograph was significantly more effective than the control group. There were no significant differences for the externally-paced low level group.

For the medium level, externally-paced, the Both treatment was significantly more effective than the real photograph used alone. In the self-paced medium level group only the hybrid visual was significantly more effective than the control group.

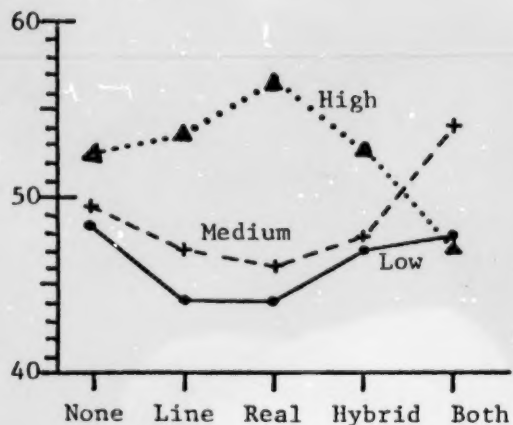


Figure 6 Terminology Test
(Externally-paced)

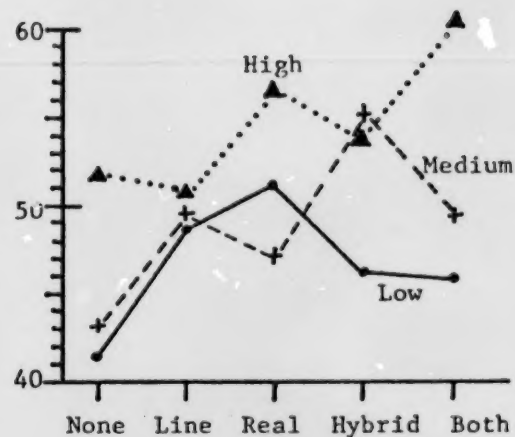


Figure 7 Terminology Test
(Self-paced)

For the high level externally-paced group, real photographs resulted in significantly higher scores than did the Both treatment. In the self-paced groups, the Both Treatment was significantly more effective than all other groups, except those receiving real photographs.

Comprehension Test

Only the prior knowledge factor produced a significant F ratio in the analysis of variance procedure for the comprehension test. As with the identification test, the low and medium level groups were not significantly different; however, both differed significantly from the high level group.

Total Score

The analysis of variance procedure for the total scores produced a significant F value for the ABC interaction. Figures 8 and 9 illustrate the AC means for externally-paced and self-paced instruction respectively.

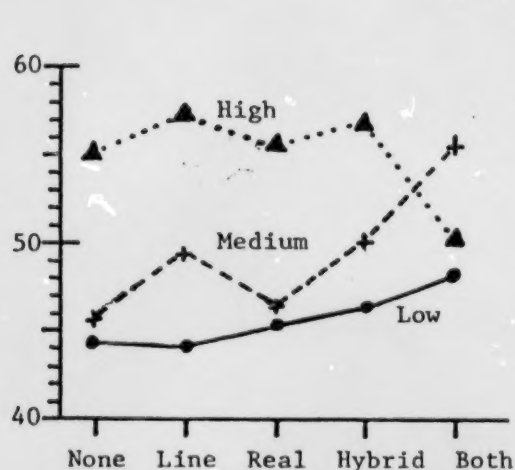


Figure 8 Total Score
(Externally-paced)

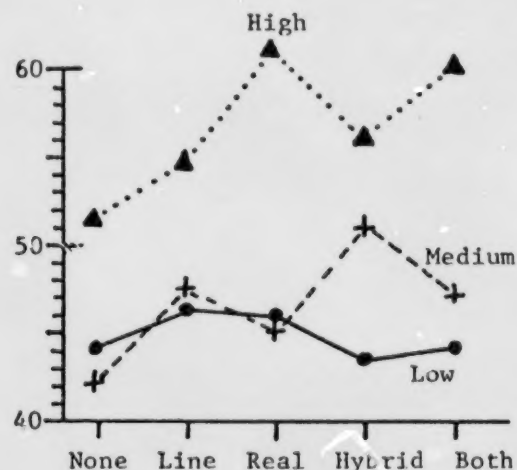


Figure 9 Total Score
(Self-paced)

There were no significant differences between the means for the low level prior knowledge group.

For the medium level, with external pacing, the Both treatment was significantly more effective than the control group treatment. Only the hybrid visual was significantly more effective than the control group treatment with self pacing.

For the high level groups, with external pacing, the line drawing was significantly more effective than both types of visuals presented together.

For the self-paced groups, the real photograph and the Both treatment were significantly more effective than no visuals at all (control).

Delayed Posttest: Discussion

Delayed retention for subjects with a low level of prior knowledge of the subject was not generally influenced by the type of visualization. The one exception occurred with the terminology test in which these subjects, when utilizing self-paced instruction, found the realistic visual most effective. Apparently, the realistic visual enhanced long term memory for the kind of knowledge measured by the terminology test.

For students with moderate levels of prior knowledge, delayed retention was influenced by the type of visual for the kind of learning measured by the terminology test and the total test scores. These students who received externally-paced instruction benefited most from presentation of both types of visuals. When instruction was self-paced, the hybrid visual was most effective. For long term retention, the students appear to benefit most from integration of abstract and realistic visualization, although the most effective method of integration depends on the method of instruction.

For students with a high level of prior knowledge, the results paralleled those of the immediate posttest. For self-paced instruction the presentation of realistic visuals, or both types of visuals simultaneously, was most effective. However the presentation of both types did not enhance externally-paced instruction.

As in the case of the immediate retention results, these findings lend some support to the notion that increased level of knowledge of the subject may facilitate the utilization of more realistic or integrated visuals.

Conclusions

Results of both posttests suggest that designers of visualized instruction should consider the student's level of knowledge of the subject in determining the type of visualization to be used. Although students with a low level of general knowledge of the subject may find all types of visuals equally effective, students with moderate and high levels of knowledge of the subject may benefit from realistic visualization or illustrations which integrate abstract and realistic visualization, depending on the pacing of the instruction and the type of instructional objective.